

TITLE OF THE INVENTION

ELEVATOR DOOR UNIT HAVING MECHANISM TO RELEASE LOCK
UNIT MANUALLY IN EMERGENCY

CROSS-REFERENCE TO RELATED APPLICATIONS

5 This application is based upon and claims the
benefit of priority from prior Japanese Patent
Application No. 2003-044677, filed February 21, 2003,
the entire contents of which are incorporated herein by
reference.

10 BACKGROUND OF THE INVENTION

1. Field of the Invention

 The present invention relates to an elevator door
unit, and more particularly, to an elevator door unit
having a mechanism which manually releases a lock unit
15 of a cage in an emergency such as a power failure.

2. Description of the Related Art

 A cage of an elevator may make an emergency stop
in sections other than a landing hall of a building
when a power failure or other emergency conditions
20 occurs. A passenger in the cage may open the cage door
by force. If the cage door is opened forcibly from the
inside of the cage, passengers will be exposed to
danger. For example, passengers may fall into a shaft.
Particularly, an elevator for viewing the outside has
25 an open part where a cage is not surrounded by shaft
walls. If a cage makes an emergency stop in this open
part and a cage door is opened by force, passengers

will be exposed to more danger. Therefore, a cage door is configured not to be opened forcibly from the inside of a cage.

5 In some elevator, the inside atmospheric pressure of a cage is controlled. A cage is airtight. When an elevator makes an emergency stop because of a power failure or other accidents, a cage door can be manually opened a little to let fresh air into a cage. However, if a cage door should be opened wide, passengers will
10 be exposed to danger of falling, and the opening width of a cage door must be strictly limited.

An elevator is provided with a cage door lock unit. The cage door lock unit locks a cage door by limiting the cage door opening width, so that
15 passengers are not exposed to danger even if a passenger attempts to open the cage door from inside.

The cage door lock unit has a lock pin driven by a solenoid as a driving source. The lock pin is urged by a spring so as to project in one direction. When
20 electricity is applied to the solenoid, the solenoid moves the lock pin against the spring, and unlocks the cage door. In case of emergency such as a power failure or other accidents, the lock pin is pushed out by the spring, and the cage door is held locked.

25 A gate is provided in a landing hall of each floor of a building. A hall door is provided in each gate. The hall door is provided with a hall door lock unit.

An elevator has an engagement unit. When a cage arrives at a certain floor and a cage door coincides with a hall door, the engagement unit engages the cage door with the hall door. The lock of the hall door lock unit is released by the mechanical operation caused by this engagement. An electric signal is generated by the release of the hall door lock unit, and based on this electric signal, electricity is applied to the solenoid of the cage door lock unit. As a result, the lock pin is driven and the lock of the cage door is released. The cage door is provided with a drive unit. When the drive unit is operated, the cage door is opened together with the hall door. Then, passengers can get on or off the cage.

After passengers get on or off, the cage door and hall door are closed by the drive unit. When the hall door is completely closed, the hall door lock unit operates mechanically to lock the hall door. An electric signal is generated by locking the hall door, and the application of electricity to the solenoid is stopped by this electric signal. The lock pin is urged by the spring to lock the cage door.

If the cage should be stopped at a position where the cage door does not coincide with the hall door in case of emergency, the cage door is prevented by the cage door lock unit from being opened forcibly by a passenger. Even in the case of emergency stop, as long

as the cage door coincides with the hall door, the cage door lock unit can be manually operated and unlocked from the landing hall side. The cage door lock unit is unlocked by the manual operation using a push member
5 which pushes mechanically the lock pin. Passengers confined in the cage are rescued by unlocking the cage door lock unit from the landing hall side.

However, even if the cage stops in an emergency at a position where the cage coincides with the hall door,
10 passengers in the cage cannot unlock the cage door lock unit and escape from the cage by their own efforts. The passengers left in the cage must wait for rescue from the outside. Particularly, when a cage stops under emergency conditions such as an earthquake and
15 fire, passengers are confined in the cage and cannot escape from the cage, though the cage is stopping at the landing hall.

BRIEF SUMMARY OF THE INVENTION

It is an object of the present invention to
20 provide an elevator door unit, which allows manual opening of a cage door and a hall door from the inside of the cage when the cage makes an emergency stop in a range of facing to the hall door at a landing hall.

According to an aspect of the prevent invention,
25 there is provided an elevator door unit comprising a cage door, a cage door lock unit, a hall door, and a lock release unit. The cage door is provided in

a cage which moves in a shaft. The cage door lock unit limits and locks the opening width of the cage door to the width not to permit a passenger pass through.

5 The hall door is provided at a landing hall, and opened interlocking with the cage door when the cage stops in a range of facing to the cage door. The lock release unit releases the cage door lock unit within the opening width by manually opening the cage door when the cage is in a range that the cage door faces to the
10 hall door.

In this case, a preferable lock release unit is provided with a trigger plate and a push roller. The trigger plate is provided in a cage and interlocked with the door lock unit. The push roller is provided
15 in the hall door, and presses the trigger plate and releases the cage door lock unit while the cage door is being opened within the opening width.

A further preferable form of the trigger plate has a length along the vertical direction of a cage.
20 Operation of the trigger plate is transmitted to the door lock unit by a gear mechanism and a cam mechanism. The trigger plate is also preferable to be elastically urged by a spring in the reverse direction to the cage door lock unit releasing operation. The trigger plate
25 is provided at a position where the cage does not interfere with the push roller of the hall door during moving. It is also effective that the door lock unit

is provided with a driving source which electrically unlocks the cage door.

With the elevator door unit configured as described above according to the present invention, when the cage makes an emergency stop in the range of facing to the hall door at a landing hall, a passenger can manually open the cage door and hall door from the inside of the cage, and escape from the cage.

Additional objects and advantages of the invention will be set forth in the description which follows, and in part will be obvious from the description, or may be learned by practice of the invention. The objects and advantages of the invention may be realized and obtained by means of the instrumentalities and combinations particularly pointed out hereinafter.

BRIEF DESCRIPTION OF THE SEVERAL VIEWS OF THE DRAWING

The accompanying drawings, which are incorporated in and constitute a part of the specification, illustrate embodiments of the invention, and together with the general description given above and the detailed description of the embodiments given below, serve to explain the principles of the invention.

FIG. 1 is a sectional view showing a primary configuration of an elevator according to one embodiment of the present invention;

FIG. 2 is a front view of a cage of the elevator shown in FIG. 1 seen from the cage door side;

FIG. 3 is a sectional view of a cage door lock unit and a lock release unit of the door unit shown in FIG. 2;

5 FIG. 4A is a front view showing the state that the lock pin of the cage door lock unit shown in FIG. 3 is engaged with a regulation member, and the cage door is closed;

10 FIG. 4B is a front view showing the state that the lock pin of the cage door lock unit shown in FIG. 3 is engaged with a regulation member and the cage door is opened;

15 FIG. 4C is a front view showing the state that the lock pin of the cage door lock unit shown in FIG. 3 is disengaged from a regulation member and the cage door is opened;

FIG. 5 is a plan view showing the structure of the lock release unit shown in FIG. 3;

20 FIG. 6 is a plan view showing the structure to urge elastically a trigger plate of the lock release unit shown in FIG. 3; and

FIG. 7 is a perspective view of a tool for manually operating the lock release unit shown in FIG. 3.

DETAILED DESCRIPTION OF THE INVENTION

25 Description will be given on the elevator door unit according to an embodiment of the present invention with reference to the accompanied drawings.

As shown in FIG. 1, an elevator comprises a shaft 1, a cage 2, a main rope 3, a winch, a landing hall 4, a gate 5, and hall doors 6a and 6b. The shaft 1 is provided vertically in a building. The cage 2 is
5 suspended by the main rope 3 in the shaft 1. The main rope 3 is wound around the winch. By driving the winch, the cage 2 is moved up or down within the shaft 1. The landing hall 4 is provided at each floor of a building. The gate 5 is formed to connect the
10 landing hall 4 to the shaft 1. The hall doors 6a and 6B are provided in the gate 5, and constructed as double doors in this embodiment.

The cage 2 comprises a cabin 10, an entrance 11, and cage doors 12a and 12b. The entrance 11 is formed
15 in the side facing to the hall doors 6a and 6b. The cage doors 12a and 12b are located just like closing the entrance 11 as shown in FIG. 2, and double doors in this embodiment.

The cage 2 has a member-mounting frame 15
20 extending horizontally in the outside of the cabin 10 and above the entrance 11, and has a threshold 23 in the outside of the cabin 10 and under the entrance 11. The member-mounting frame 15 is provided with a hanger rail 16 extending horizontally in the side facing to
25 the hall door 6a/6b. The hanger rail 16 comprises a horizontal part and a vertical part. The horizontal part extends from the member-mounting frame 15 toward

the hall door 6a/6b. The vertical part extends upward from the front end of the horizontal part.

5 The cage doors 12a and 12b have hanger 20a and 20b at the upper end. The hanger 20a/20b has a pair of hanger rollers 21 mounted rotatable in the cabin 10 side. The cage doors 12a and 12b are hung on the hanger rail 16, so that the hanger roller 21 rolls contacting on the upper surface of the horizontal part of the hanger rail 16. The lower ends of the cage doors 12a and 12b are fit in the threshold just like sliding.

15 The door-driving unit for sliding the cage doors 12a and 12b are provided in the member-mounting frame 15. The door-driving unit slides the cage doors 12a, 12b in the direction of approaching or separating each other along the hanger rail 16 and threshold 23. As a result, the entrance 11 of the cabin 10 is opened and closed.

20 The cage 2 is provided with a cage door lock unit 25 which restricts the opening width of the cage doors 12a, 12b. The cage door lock unit 25 is provided above the ceiling of the cabin 10 and above the doorstop in the state that the cage doors 12a and 12b are closed.

25 The door lock unit 25 comprises a frame 26, a lock pin 27, a solenoid 28, a plunger 29, a compressed spring 30, and regulation members 32a and 32b, as shown

in FIG. 3. The frame 26 is provided on the member-mounting frame 15 above the cabin 10. The lock pin 27 penetrates the frame 26, sliding across the plane along the cage doors 12a, 12b. The end of the lock pin 27 projects from the side walls of the cage doors 12a, 12b of the frame 26 toward the hall doors 6a, 6b forward of the cabin 10. The lock pin 27 is provided halfway with a lock release roller 31 which rotates on the plan parallel to the ceiling of the cabin 10.

The solenoid 28 and plunger 29 are the driving source which electrically releases the lock of the cage doors 12a, 12b. The solenoid 28 drives the plunger 29 in the axial direction by the magnetic force generated when electricity is applied. The plunger 29 is connected to the lock pin 27. The compressed spring 30 is inserted onto the lock pin 27 opposite to the plunger 29 with respect to the frame 26, and urges the lock pin 27 elastically in the direction of separating from the solenoid 28.

The regulation members 32a and 32b are provided in the front sides of the hangers 20a and 20b, respectively, that is the side facing to the hall doors 6a and 6b. The regulation members 32a and 32b have engagement holes 33a and 33b formed long in the horizontal direction. The regulation members 32a and 32b are overlapped in the state that the cage doors 12a and 12b are completely closed, as shown in FIG. 4A.

The end of the lock pin 27 is inserted into the engagement holes 33a and 33b of the cage door lock unit 25 in the locked state.

5 The engagement holes 33a and 33b have the length to permit manual sliding of the cage doors 12a and 12b from the closed state shown in FIG. 4A to the slightly opened state shown in FIG. 4B, with the lock pin 27 inserted. The opening width L of the cage doors 12a and 12b shown in FIG. 4B is limited to the width that
10 a passenger cannot pass through. Actually, the opening width L is preferably about 10cm. As described above, the opening width L of the cage doors 12a and 12b is locked by the lock pin 27 of the cage door lock unit 25 in the normal state.

15 The solenoid 28 generates a magnetic force when electricity is applied, and attracts the plunger 29 against the elastic force of the compressed spring 30. The lock pin 27 connected to the plunger 29 moves together with the plunger 29 rearward of the cabin 10
20 in the direction of separating from the hold doors 6a and 6b. The end of the lock pin 27 is pulled out of the engagement holes 33a and 33b, and the cage doors 12a and 12b are unlocked. Therefore, the door-driving unit permits opening of the cage doors 12a and 12b as
25 shown in FIG. 4C. The hall doors 6a and 6b are interlocked with the cage doors 12a and 12b by the engagement unit when the cage 2 stops at the position

facing to the cage doors 12a and 12b.

An elevator further comprises a lock release unit 37 in this embodiment. The lock release unit 37 comprises a bracket 38, rotary shafts 39 and 40, a cam 42, a gear 43, a trigger plate 45, a gear 46, a lock release roller 31, and a push roller 50, as shown in FIG. 3 and FIG. 5. The lock release unit 37 makes it possible to manually open the cage door lock unit 25 from the inside of the cabin 10 when the cage 2 stops in the range that the cage doors 12a and 12b face to the hold doors 6a and 6b.

The bracket 38, whose base is fixed to the frame 26, extends forward to the hall doors 6a and 6b crossing the cage door lock unit 25 and cage doors 12a, 12b. The rotary shafts 39 and 40 are provided in the vertical direction from the horizontal part of the bracket 38 to the cage door lock unit 25. The cam 42 and gear 43 are fixed as a single unit, and fit rotatable on the rotary shaft 39. The trigger plate 45 is fit to the rotary shaft 40 through a boss 45a. The gear 46 is fit to the rotary shaft 40 so as to rotate as a single unit together with the boss 45a. The gears 43 and 46 are engaged each other.

The trigger plate 45 is fixed to the arm projecting from the circumference of the boss 45a to the rotation radius direction, and extends downward parallel to the rotary shaft 40 up to the position to

overlay on the top of the cage door 12a, as shown in
FIG. 2. One section of the circumference of the cam 42
has a cam part 42a with different rotation radius, as
shown in FIG. 5. The cam part 42a rolls contacting on
5 the lock release roller 31 fixed to the lock pin 27.

At the lower end of the rotary shaft 40, a fitting
part 40a having a square cross section is formed to fit
with a fitting hole 55a of a handle tool 55 shown in
FIG. 7. The handle tool 55 is operated from the
10 outside of the cabin 10 to rotate the rotary shaft 40.

An arm 48 extending further in the radial
direction is fit to the rotary shaft 40, as shown in
FIG. 6. The rotation front end of the arm 48 is urged
in the counterclockwise direction in FIG. 6 by a
15 compressed spring 49 whose one end is supported by a
part of the top of the cage 2. The side of the arm 48
opposite to the side touched by the compressed spring
49 is elastically touched to an elastic element 2b such
as rubber provided on the wall part 2 on the top of the
20 cage 2. In the state that the arm 48 touches the
elastic element 2b, the lock release roller 31 touches
that part of the cam part 42a which has a small radius
of rotation. Since the arm 48 is held between the
elastic element 2b and compressed spring 49, the
25 trigger plate 45 does not accidentally swing while the
cage 2 is moving.

The push roller 50 is provided on the hall door

6a, one of the two hall doors 6a and 6b, as shown in
FIG. 2 and FIG. 5. The push roller 50 is supported by
the rear side of the hall door 6a facing to the cage
doors 12a and 12b, and rotatable centering around a
5 vertical shaft 51. When the cage 2 is in the range
where the cage doors 12a and 12b face to the hall doors
6a and 6b, the push roller 50 and trigger plate 45 are
located adjacent in the horizontal direction. The
trigger plate 45 and push roller 50 are provided at the
10 position not interfering with each other when the cage
2 is moved.

Description will be given on the operation of the
door unit based on the above-mentioned configuration.

First, explanation will be given on the normal
15 operation of the door unit.

While the cage 2 is moving, the cage doors 12a and
12b are closed and locked by the cage door lock
unit 25. Each floor is provided with a switch which
detects arrival of the cage 2. When the cage 2 stops
20 at the landing hall 4 of an object floor, the switch
outputs an arrival signal indicating that the cage 2 is
stopped at that floor.

When the arrival signal is outputted and the
solenoid 28 is supplied with electricity, the plunger
25 29 is involved into the solenoid 28. Since the lock
pin 27 connected to the plunger 29, the front end of
the lock pin 27 is removed from the engagement holes

33a and 33b, and the cage doors 12a and 12b are unlocked. While the cage 2 is stopping at the same floor, the cage door lock unit 25 holds the cage doors 12a and 12b unlocked by continuously applying
5 electricity to the solenoid 28.

When the cage 2 arrives at the landing hall 4, the cage doors 12a and 12b engage with the hall doors 6a and 6b provided in that landing hall 4 through the engagement unit. When the cage 2 arrives at the
10 landing hall 4, the hall door lock unit provided separately in the hall doors 6a and 6b of that landing hall 4 is released. When the cage doors 12a and 12b are slid by the door-driving unit in the direction of separating from each other, the hall doors 6a and 6b
15 interlocked with the cage doors 12a and 12b are also moved, and the entrance 11 of the cabin 10 and the gate 5 of the landing hall 4 are opened.

After passengers get on or off the elevator, the cage doors 12a and 12b are slid by the door-driving
20 unit, and closed together with the hall doors 6a and 6b. When the cage doors 12a and 12b are closed, the supply of electricity to the solenoid 28 is turned off. Since the plunger 29 is removed from the solenoid 28, the lock pin 27 is projected to the front side of
25 the cage 2 by the urging force of the compressed spring 30, and inserted into the engagement holes 33a and 33b of the overlapped regulation members 32a and 32b.

When the cage doors 12a and 12b are locked, the cage 2 is permitted to move toward the next object floor.

Next, explanation will be given on the operation of the door unit when the elevator stops in an emergency such as a power failure.

When the cage 2 makes an emergency stop in sections other than the landing hall 4 or in the range that the cage doors 12a and 12b don't face to the hall doors 6a and 6b, the lock pin 27 of the cage door lock unit 25 is inserted into the engagement holes 33a and 33b formed long in the moving direction of the cage doors 12a and 12b, as shown in FIG. 4A.

The cage doors 12a and 12b, when opened forcibly by hand from the inside of the cabin 10, open only by the opening width L corresponding to the length of the engagement holes 33a and 33b, as shown in FIG. 4B. Particularly, in the case of cage 2 having the air tightness of the degree to permit adjustment of the internal pressure, the opening of the cage doors 12a and 12b helps natural ventilation of the cabin 10 in an emergency, even though the opening width is a little. The opening width L is limited to the width not to permit passengers to pass through.

Since the cage doors 12a and 12b don't open unnecessarily, passengers are not exposed to danger to fall down from the cage 2. When a rescue team member goes into the shaft 1 and manually operates the

fitting part 40a by using the handle tool 55, the cage door lock unit 25 is released. After a rescue team member releases the cage door lock unit 25 from the outside of the cabin 10, passengers can escape from the cabin 10.

When the cage 2 makes an emergency stop in the section of the landing hall 4 or in the range that the cage doors 12a and 12b face to the hall doors 6a and 6b, the cage doors 12a, 12b and hall doors 6a, 6b are engaged with each other through the engagement unit, and the push roller 50 and trigger plate 45 are located adjacent in the sliding direction of the hall doors 6a and 6b. Even if the cage 2 stops at the position shifted slightly upward or downward from the landing hall 4, the cage doors 12a, 12b and hall doors 6a, 6b are engaged with each other through the engagement unit. Since the trigger plate 45 is long enough in the vertical direction, the push roller 50 and trigger plate 45 are also located in the range adjacent to the sliding direction of the hall doors 6a and 6b.

When the cage doors 12a and 12b are forcibly opened by hand from the inside of the cabin 10, the hall doors 6a and 6b are also opened interlocking with the cage doors 12a and 12b. The push roller 50 fixed to the hall door 6a comes in contact with the trigger plate 45 and rotates the trigger plate 45 with the gear 46 in the clockwise direction in FIG. 5

centering around the rotary shaft 40, against
the compressed spring 49. The gear 46 rotates the
cam 42 counterclockwise through the gear 43 engaged.
By the rotation of the cam 42, the lock release roller
5 31 moves away from the rotary shaft 39.

As a result, the lock pin 27 is moved against the
compressed spring 30, and the front end is removed from
the engagement holes 33a and 33b before the cage doors
12a and 12b are opened to the state shown in FIG. 4B.
10 The cage doors 12a and 12b are unlocked, and can be
opened as shown in FIG. 4C.

Further, the gear ratio between the gears 46 and
43 is set large. By the slight movement of the hall
door 6a, the lock pin 27 is moved largely. Therefore,
15 the cage doors 12a and 12b are certainly released. The
cam part 42a of the cam 42 is shaped not to move the
lock release roller 31 after the trigger plate 45
rotates to a certain range. Therefore, it is prevented
to break the cam part by pressing excessively the lock
20 release roller 31.

When the cage 2 stops in an emergency in the range
that the cage doors 12a and 12b face to the hall doors
6a and 6b, this elevator door unit can release the cage
door lock unit 25 by opening the cage doors 12a and 12b
25 slightly by force. Therefore, passenger in the cabin
10 can open the cage doors 12a, 12b and hall doors 6a,
6b by hand from the inside of the cabin 10, and escape

speedily from the cage 2 to the landing hall 4 without waiting for rescue.

Further, in the elevator door unit configured as described above, the cage doors 12a, 12b and hall doors 5 6a, 6b are interlocked. Therefore, if only the cage 2 stops at the section of the landing hall 4, the cage door lock unit 25 can be released by opening forcibly the hall doors 6a and 6b from the landing hall 4, and the cage doors 12a and 12b can be opened by hand.

10 Further, when the hall doors 6a and 6b are opened to the position where the push roller 50 is moved beyond the trigger plate 45, the trigger plate 45, cam 42 and lock pin 27 are returned to the initial position by the urging force of the compressed springs 49 and 15 30. However, as the cage doors 12a and 12b have already been opened, they are not re-locked by the cage door lock unit 25.

Though the explanation has been given based on the double-door type cage door and hall door in this 20 embodiment, the present invention is applicable also to a single-door type.

Additional advantages and modifications will readily occur to those skilled in the art. Therefore, the invention in its broader aspects is not limited to 25 the specific details and representative embodiments shown and described herein. Accordingly, various modifications may be made without departing from

the spirit or scope of the invention as defined by the appended claims and equivalents thereof.